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El Zahrawi (936–1013 AD), the father of operative surgery

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Introduction

It gives me great pleasure to introduce to you a pioneer teacher of surgery who lived a thousand years ago and who was famous for many centuries but whose name was forgotten again for many centuries. In recent years his importance and his greatness have become realised by some surgeons and historians and he has been regaining the prestige that he is worthy of. That great colleague and pioneer teacher is El Zahrawi—Abu Al Gasim Khalaf Ibn Abbas. In European languages his name is written in more than a dozen ways *(1,2)*:

Abulcases
Albucasis
Bulcasis
Bulcasim
Bulcari
Alzahawi
Ezzahrawi
Zahravius
Alcarani
Alsarani
Alcaravi
Alcaravius
Alsahrawi

Who was El Zahrawi?

El Zahrawi (Fig. 1) was an Arab surgeon who lived in 'Andulesia'—Spain—when it formed an important part of the vast Islamic-Arabic empire. He was born in 936 *(3)* and

FIG. 1 El Zahrawi—Abu Al Gasim Khalaf Ibn Abbas.

died in 1013 *(4)*, and his life span falls within the period of time when the Islamic-Arabic civilisation was at its zenith throughout the whole empire and especially so in Spain *(5)*.

Abu Al Gasim mastered the art of surgery and practised many of its various branches with remarkable success *(6)*. He devised many surgical procedures and elaborately explained how they were to be performed. He invented many surgical instruments and explained in detail the methods of using those instruments *(1)*. He was the first surgeon to illustrate by drawings the type, shape, and size of instruments required for the various operations *(7)*. In some pages of the books he wrote the drawings occupied more space than the text *(2)*.

It is clear from his life history and from his writings that he devoted his whole life and genius to the advancement of medicine as a whole and of surgery in particular *(7)*. Unlike all his great contemporaries, and unlike all the great physicians of ancient times he was not famous for being a philosopher, mathematician, linguist, astronomer, or theologist.

El Zahrawi wrote a medical encyclopaedia which fills 30 volumes and contains sections dealing with surgery, medicine, ophthalmology, orthopaedics, nutrition, pharmacology—in short, all branches of medical practice *(7,8)*. He called his book *El Tasreef* and it became so popular that it displaced Avicenna's *Canon* as the textbook for medical education in many of the universities of Europe from the 12th to the 17th century AD *(9)*.

The environment in which El Zahrawi lived

Abu Al Gasim was born in and called after the town of El Zahra, a suburb of Cordova, which was then the capital of Spain. He lived during the reign of King Abdel Rahman the Third, famous as El Nasir, who ruled Andulesia for the 50 years which formed the peak of the well-known 'Golden age' which flourished in Spain during the Arabic domination *(9)*. There was wealth and prosperity as well as learning and knowledge everywhere *(8,10)*.

The capital, Cordova, was known as the 'Ornament of the World' *(2)*. Its population was a quarter of a million and it had a library which contained 600,000 books *(8)*. Every boy in that city was able to read and write by the age of 12. There were six schools of university standard in Andulesia, scattered throughout the country, and each of them contained large hostels for its students. There were over 70 public libraries, all similar to that of Cordova *(11)*.

Abdel Rahman El Nasir built the suburb of Zahra about 5 miles out of Cordova as a special resort for himself, and he named it after his favourite wife, El Zahra *(5,10)*. He encouraged notables and other people to build by his side and gave a grant of 400 'deenars' (pounds) to whoever built a house in El Zahra *(12)*.

It was in this highly civilised and sophisticated environment that El Zahrawi arose *(10)* and it is therefore not surprising that many of his works were of such high standard

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that many of them compare very favourably with a good deal of what we have today.

Evaluation of the work of El Zahrawi

El Zahrawi's book *El Tasreef*, is 1500 pages long and contains 200 drawings *(10)* (Fig. 2). It was translated into Latin and into most of the European languages. Unfortunately there is no complete collection of its 30 volumes *(7)* in any one library in the world, but some volumes, in various languages, are to be found in some Arabic countries (Cairo, Damascus, Baghdad, Rabat, and Istanbul) as well as in some European countries (Paris, London, Oxford, the Vatican, Bologna, and Venice) *(1,2)*.

THE USE OF CAUTERISATION IN TREATMENT *(7,8)*

Cauterisation had been known to the Arabs from ancient times, but El Zahrawi was the first to advocate limitations of its use and to define the mode of its application. He invented different shapes of cautery tools to be used purposefully in different parts of the body: the 'nail-like' for backache and headaches, the 'pointed' for narrow places, the 'saw-like' for the nose, the 'cresentic' for the eyelids, and the 'knife' for the lip *(8)*.

He made three fascinating observations in connection with the use of metals for cautery *(1)*:

He noted that when iron is heated it becomes red at first and when heated further it becomes white. He advised the use of red-hot iron for cautery because it coagulates tissues, while white-hot iron cuts like a knife.

He advocated the use of iron in cautery in preference to copper and gold because the latter cool quickly and if you heat them beyond a certain stage they melt. The truth of his observations is confirmed by our modern knowledge that the melting point of gold is 1063 °C, while that of iron is 1535 °C.

He preferred cautery with metals to cautery with caustic drugs because with the former you can judge the amount of cauterisation you are producing, while with the latter this is not easy and neighbouring tissue can inadvertantly be damaged, maybe irreversibly.

FRACTURES AND DISLOCATIONS

El Zahrawi wrote extensively about these conditions and did not miss even those of the nasal bones, the jaws, and the vertebrae *(1)*. He noted that fractures and dislocations may coexist and that wounds may complicate the picture further.

He used egg-yolk for immobilisation of fractures and he opened a window in the cast for treating a concurrent wound *(2)*. He described vividly the method now named after Kocher for reducing dislocation of the shoulder joint *(2)*.

OPHTHALMOLOGY

El Zahrawi described an operation for treating entropion trichiasis which is probably as efficient as the method popular nowadays *(8)*. He removed a wedge of skin from the eyelid, then made a release incision in the conjunctiva, and then sutured the skin edges together. In this way the edge of the eyelid is rotated outwards over the edge of the tarsal plate, carrying the hairs away from eyeball.

He describes the treatment of pterygium as follows *(8)*: 'Insert a needle under the pterygium and raise it. Then insert a horse-tail hair under it and saw off the part lying outside the cornea by moving the hair sideways. Then remove the part on the cornea with a sharp, smooth blade'. These are El Zahrawi's own words and this is almost exactly the operation used now (but not with a horse hair of course).

For cataract he said *(8)*: Take a pointed scalpel, insert it in the limbus until it reaches the cataract, and then lever it downwards. The patient sees at once'.

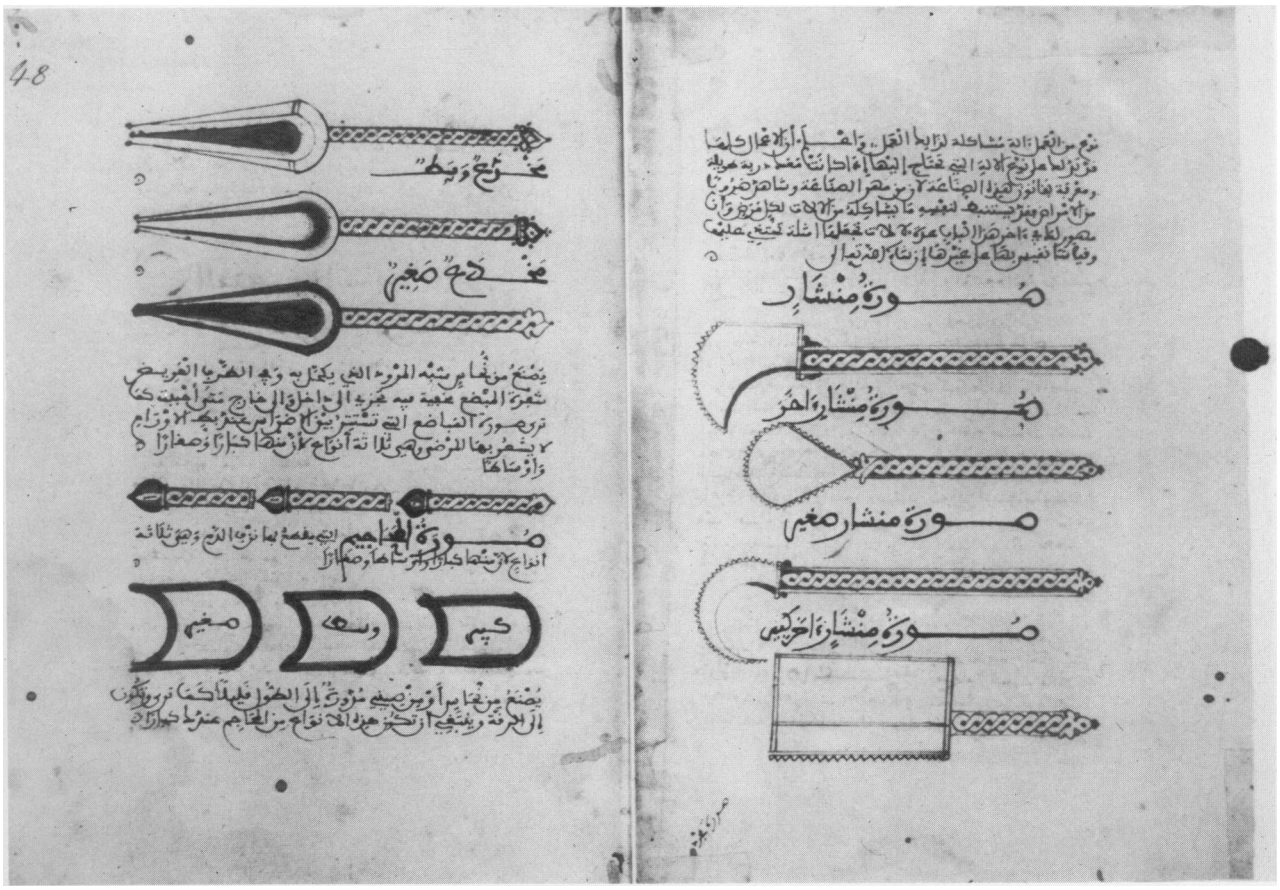

FIG. 2 A page from *El Tareef* with drawings of various surgical instruments. On the left, from above downwards, are large, medium, and small scalpels with handles; three sizes of tool for arresting bleeding; and three sizes of scalpel of a different type. On the right are four types of saw. Between the drawings are comments about their usage, size, and the metals from which they should be made, mostly copper, iron, or gold.

Hypopion was treated by incision in the limbus and drainage *(8)*.

E N T SURGERY *(1,8)*

For tracheostomy he said: 'Count three or four rings of the windpipe and cut the membrane lying between two cartilages and then attach the cartilages to the skin'.

For tonsillectomy he said: 'Depress the tongue by means of a tool, then insert a hook in the tonsil and pull it outwards and then cut it by means of strong scissors'.

DENTISTRY *(2,8)*

El Zahrawi devised various types of forceps for extraction of teeth and described the fixation of loose teeth by wire made of gold or silver. He advised replacing teeth that are traumatised out of their sockets because they may hold again. He suggested the use of animal bones for making false teeth. He treated epulis by excision followed by curettage or cautery.

SURGERY OF BLOOD VESSELS *(8)*

El Zahrawi wrote about 'pulsating' and 'non-pulsating' vessels, which means that he was conscious of the difference between arteries and veins *(7)*. He was the first surgeon to use the aneurysm needle and it is said that he was the first to use catgut *(2)*.

He pointed to the following facts: (*a*) Arteries retract when they are cut across and, if small, stop bleeding. (*b*) Incomplete cutting of arteries causes much bleeding. (*c*) Arteries bleed from both ends when cut across. (*d*) There is a possibility of late haemorrhage if wounds do not remain clean. (*e*) Bleeding can be stopped by digital pressure, cautery, dry dressings, or cold water.

He described in great detail how to expose the temporal artery and divide it—an operation that was used for the treatment of persistent headache.

UROLOGY

El Zahrawi described operations for: (*a*) children born without an external urinary opening or with a narrow or abnormally placed opening *(1)*; (*b*) circumcision, enumerating the various mistakes committed in its practice *(8)*; (*c*) retention of urine and use of catheters *(2)*; (*d*) removal of bladder stones through a perineal incision (in great detail) *(3,8)*; and (*e*) diversion of urine to the rectum in males and vagina in females *(8)*.

OBSTETRICS

El Zahrawi was the first to describe 'Walcher's position' for difficult labour *(2,7)* and 'Credé's method' for extraction of the retained placenta *(2)*. He also described perforating the fetal head and emptying it in order to permit delivery. He devised and used forceps applied to the fetal head to pull on it *(8)*; thus he preceded the famous Chamberlen family in the use of forceps in obstetrics.

OTHER OPERATIONS *(1)*

In addition to those described above El Zahrawi devised operations for: (*a*) inguinal hernia; (*b*) hydrocele; (*c*) varicocele; (*d*) haemorrhoids and anal fistulae; (*e*) supernumerary and fused digits; (*f*) ingrowing nails; (*g*) large male breasts or excessively large female breasts; and (*h*) hermaphroditism.

Conclusion

Let me now invite El Zahrawi himself to speak to you *(7)*:

'Now my sons, having finished for you this book on the knowledge of medicine, I would like to conclude with this chapter which deals with the subject of "working with one's own hands". In our present time the art of working with one's own hands has, unfortunately, come to be regarded as a disgrace. This is the reason why there are no expert surgeons nowadays. Another reason is that preparation for the medical profession is a long and tedious course and those who take it must acquaint themselves with a good knowledge of the science "anatomy", which was described by Galen, so that they will know the uses of the organs, their shape and form as well as their relations and interactions *[7]*. They should know the bones, the nerves, the muscles, and the pulsating and non-pulsating vessels, their numbers and their origins and insertions *[2,7]*'.

He goes on to say *(7)*: 'Because there are so many who lack such knowledge Galen said: "Doctors by name are many, but in actual fact they are few". This is especially true as far as working with the hands is concerned because those who lack a good grasp of anatomy are prone to commit serious and even fatal mistakes. [He quotes two examples.] My sons, I would like you to know that there are two kinds of "working with our hands": that which is accompanied by safety and that which ends in disaster. I have therefore drawn your attention in every section of this book to the kind of work that is disastrous so that you will avoid embarking on it and thereby avoid giving chances to the ignorant and the wicked who are always ready to defame you. So please seek dignity and conscientiousness for yourselves and assurance and safety for your patients. Beware of things that will arouse suspicion in your character and in your religion'.

If El Zahrawi was living with us today I imagine he would add: 'My sons, you have at your service such elaborate and reliable means of examination and investigation as should enable you to make the most accurate diagnosis of the patient's disease and its extent. This in turn should enable you to work out the right method of treatment. Remember that operation is only a stage in the management of the patient and it is essential to know exactly what is to be done before it and after it'.

Lastly, I think El Zahrawi's name was forgotten for so many centuries for two reasons: firstly, his name was altered and distorted in so many ways; and secondly, those who copied his works did not refer to him as being the source of their knowledge.

This is the story of Abul Gasim Khalaf Ibn Abbas, El Zahrawi, who, in my opinion, should be regarded as 'The Father of Operative Surgery'.

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